MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

TCS 3311 – COMPILER DESIGN/ TCP2451 – PROGRAMMING LANGUAGE TRANSLATION

(All Sections / Groups)

11 March 2016
9 AM – 11 AM.
(2 Hours)

INSTRUCTION TO STUDENT

1. Answer **ALL** questions.
2. This question paper has 4 printed pages excluding the front cover.
3. Please print all your answers in the answer booklet provided.

QUESTION 1

(a) For a regular expression:

(a* | b*) a

Draw a NFA that can recognize the regular expression using Thompson's construction approach. The alphabet set is {a, b}.

[5 marks]

(b) Name two main differences between a NFA and a DFA.

[4 marks]

(c) Convert the NFA you derived in question 1(a) to a DFA using subset construction method. Also show the generated transition table.

[6 marks]

Continued .....

QUESTION 2

(a) Given a BNF grammar bellow, remove left recursion in the grammar

E→ E + T | T
T → T * F | F
F → (E) | id

[3 marks]

(b) Compare the BNF grammar of question 2(a) with the left recursion eliminated grammar you produced, which one is an ambiguous grammar or neither. Justify your answer.

[2 marks]

(c) Perform a FIRST and a FOLLOW operation on each of the non-terminals in the modified grammar of question 2(a). (Hint: Use the grammar you derived after the left recursion elimination)

[10 marks]

Continued .....

QUESTION 3

(a) Given the following grammar:

S→ # P# | E
P → P, P | E
E → /

Draw the DFA to be used to build an LR(0) shift-reduce parser. If there is any conflict, identify the kind of conflict scenario you faced and which state exactly caused the conflict.

[7 marks]

(b) Study the following production rules and semantic rules. Identify inherited attributes and synthesized attributes in the semantic rules.

PRODUCTION RULES	SEMANTIC RULES
T -> FT'	T'.inh = F.val T.val = T'.syn
T' -> *FT'$_1$	T'$_1$.inh = T'.inh x F.val T'.syn = T'$_1$.syn
T' -> ε	T'.syn = T'.inh
F -> digit	F.val := digit.lexval

[4 marks]

(c) Ensuring type-safety is done using type binding and type checking. Elaborate various type binding mechanisms and type checking mechanisms. Provide examples in your elaboration.

[4 marks]

Continued .....

QUESTION 4

a) Illustrate the quadruples three-address code approach to represent the following as intermediate code.

```
a := b * - c + b * - c
```

[6 marks]

b) Illustrate using examples how the following peephole optimizations work.
   i) Algebraic simplifications
   ii) Constant folding
   iii) Eliminating unreachable code

[6 marks]

c) Calculate the total cost of instructions for the following addressing modes

```
MOV     R0, M
MOV     4 (R0), M
MOV     *R0, M
```

[3 marks]

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